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The Cambridge Gas Stoves.

It is a mistake to suppose that combustion, however perfect, consumes the gas. It only modifies or changes its character. It causes new combinations of its component elements, especially with the oxygen of the air, which are not only offensive to the smell, but which, if inhaled into the lungs, are exceedingly deleterious to the health. This is especially true of the combustion of gas as used for heating purposes, that is, with a large admixture of atmospheric air. The oxygen thus mingled with the gas before it is lighted, enters into combination with the carbon of the flame, changing its

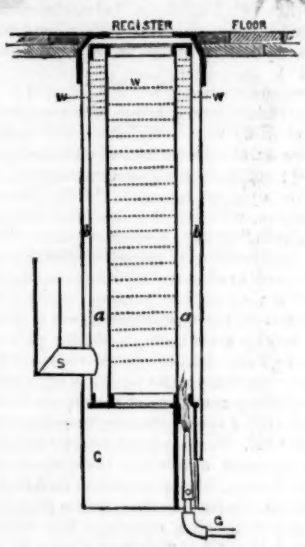

Fig. 1.

color from yellow to red, and increasing its temperature seven-fold. But in the products of combustion of gas thus used, scientific men have detected, besides many other impurities, sulphur, ammonia, and even *arsenic*, in its most subtle form.

Now the stove and furnace herein described are so constructed that the products of combustion of the gas used, however offensive or unwholesome, must of necessity pass into the chimney; thus instead of corrupting the air of the room, they in fact keep it pure by causing upward and outward current through the flues.

In the construction of them, the fact has been recognized that air can only be effectually heated by being brought into actual contact with a heated surface. It is known that direct heat, even that of the midsummer sun, does not warm the air through which it passes. When originating in a room, it is at once absorbed by the ceiling, floor, walls, and all conducting surfaces. But as the sun heats the earth, and the earth, being heated, warms the surrounding air; so in a room, direct heat may be arrested and made sensible by the interposition of surfaces which will both absorb and impart it. In accordance with these well known principles, the greatest possible extent of surface for receiving and communicating heat is supplied.

In this connection, what is especially deserving of mention as novel and successful, in the use of *wire netting*, both in the gas chamber, and in the cold-air passages. In the former, it serves to absorb and retain the heat in its passage to the chimney: in the latter, being extended in a series of horizontal layers, whose edges are in contact with the heated parts of the stove or furnace, it presents a succession of riticulated surfaces, heated by conbustion, through which the cold air being obliged to pass in small streams or jets is heated in the most rapid and effectual manner.

Fig. 2.

The application of gas, as in the furnace, to the heating of a current of pure air on its passage through pipes connected with a register, is an entirely new idea, and cannot but prove exceedingly convenient.

These stoves and furnaces have the strong commendation of those who have used them, among whom are some of the most scientific men.

Fig. 1 is a furnace designed to be placed in the cellar, or in room under that to be heated. In the diagram, *a*, *a*, represents a cylindrical sheet-iron drum made close at the top and bottom by cast iron rings, the lower ring having an opening for the burning gas to enter. The inner cylinder of this drum is open at the top and bottom, and is packed with layers of wire-netting, *w*. *C* is an outer casing of tin or galvanized iron, also open at the top and bottom. *S* is the smoke-pipe connecting with the chimney. Through this outer cylinder, the air to be heated ascends through and around the drum to the register. Simple as this arrangement is, it produces astonishing results with a very small consumption of gas.

Figs. 2 and 3, show two styles of stoves, round and oval, for heating halls and rooms.

Fig. 3. Large oval stove designed to be used like an ordinary coal stove in the room to be heated. It is constructed upon the same principle as the furnace, but without the outer casing, By means of partitions within the drum of both the stove and the furnace, the heated products of combustion are made to pass over the entire radiating surface of each. The burners are de-

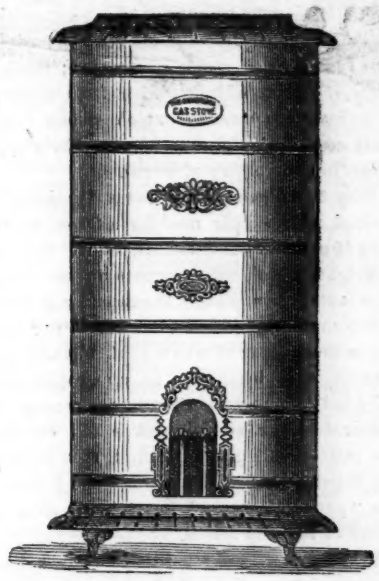

Fig. 3.

signed to consume from *four* to *six* feet per hour, and each stove is usually supplied with two, in order that a strong heat may be obtained whenever needed.

Cooking stoves and ranges upon the same plan are being brought much into use.

These stoves, etc., may be seen at Mechanics Institute Fair, 63rd street, or at 22 Pines treet office, of this Journal.

Suez Canal.—The engineer of the Suez Canal, M. Lesseps, proposes to get up an international excursion party of one hundred gentlemen of different nationalities, who are to meet at Paris next spring, and thence proceed to Egypt, to be present at the opening of the Canal. The line of the excursion from that point lies through China and Japan across the Pacific Ocean to San Francisco, and the Pacific Railroad to New York

Chemical Repertory.--No. 15.

OCTOBER 2, 1869.

American Chemical News.

ORIGINAL COMMUNICATIONS.

ON THE CONSERVATION OF FORCE.

[For some comments on this interesting discussion, we beg to refer to our general editorial page.—H. W.]

Remarks of Prof. VAN DER WEYDE, on Prof. WALLING's paper, read before the AMERICAN ASSOCIATION at Salem, Mass.

To the abstract of Prof. WALLING's paper, on the above subject, published on page 82 of this Journal, are appended a few lines, in which is accorded to me the distinction of publishing some of my objections, and also two queries of Professors HENRY and NORTON, with the pointed remark: "To these questions no reply was made."

The last remark I consider as a challenge; it is clearly intended to convey the idea that these queries were fatal to the principles claimed by me; therefore I wish to state that I felt there was lack of time at that meeting, for sufficient explanation and expansion on this, to some persons so intricate subject, so as to defend my principles as fully as Prof. WALLING had defended his, in a very extensive paper. Prof. WALLING himself found out this lack of time, when on the following day the reading of his treatise on elementary fibres was peremptorily cut short by the members present. Justice to myself would have required a separate paper on the subject, and this I may perhaps prepare for the next meeting in Troy.

I agree with Prof. WALLING that "all difficulty is removed if we admit the existence of force as a distinct entity, in *independent condition*." But in the same manner it was once considered necessary, in order to remove apparent difficulties in the theory of heat, to accept a caloric fluid, and the highest authorities of the time defended this hypothesis. Now it is rightly considered an unwarrantable assumption; much more so is force, if considered independent from matter. It is in my opinion a nonentity, which cannot possibly be clearly conceived, and of which the whole application consists in a mere play of words.

I have no objection to the term "potential energy," provided it is simply used for a force stored up by means of material contrivances, either springs wound up, weights raised, etc., in such a manner that at some future instant it will exert the capacity of setting matter into motion again; but I object to the term if applied in the manner of which Prof. WALLING has given an example in his paper, an application which has finally led him to such speculative conceptions as to consider force an entity which could be dissociated from matter. I am sorry to find that in this idea he does not stand alone, and in this sense I think that the term "potential energy" has injured clear scientific conception in many minds.

In regard to the assertion that force has disappeared in the pendulum when at its highest point, and in which Professors WALLING and NORTON appear to agree, I answer that in the pendulum, just as in the lifting of a weight, work has been done, and that the force apparently consumed is only stored up, as heat is stored up in the process of separating the carbon from carbonic acid, by the power of the sunbeam on vegetation, or as we may store up heat at any time as latent heat in steam, etc.; and even as this heat may afterward be set free and manifest itself in the combustion of the coal, or the condensation of the steam, so the force stored up when the pendulum is at its highest point, or when the weight is raised, manifests itself when the descent takes place, and we then obtainin all cases as much force, either in the form of heat or motion, as was spent or rather stored up at the outset.

In regard to Prof. HENRY's question: What becomes of the energy of a vibration of sound which should be sufficiently powerful to break a pane of glass? This amounts to the same thing as the question: What becomes of the energy of a pestle in a mortar when pounding glass to powder? In both cases the force is spent in destroying the cohesion of the particles, which was a force to be overcome, and which force of cohesion in this case can only be restored by the heat of fusion. In the case of the action of sound, a succession of regular waves, acting on a pane of glass which is apt to vibrate with the same velocity, may increase the amplitude of the corresponding vibrations of the glass pane to such an extent, as to surpass the cohesion of its particles; it is an accumulative intermittent motion, of which we often see examples. If the pane of glass were not present, the waves of sound would pass unobstructed, and in their progress raise the temperature of the transmitting medium, the air, as proved by LAPLACE, to an extent equivalent to the force producing the sound; if obstructed by the glass the waves are partially either reflected, or transmitted, or the glass itself takes part in the motion; which motion again may be converted into molecular motion or heat, or may remain motion of the mass, which in accumulating may become so strong as to overcome the force of cohesion, just as a comparatively small force constantly acting on a fly wheel, and accumulating by accelerated motion in a mass of matter, may finally exert a powerful effect.

I maintain that there is no necessity for accepting the independent existence of force; the theory that all force is nothing but matter in motion, offers a sufficient foundation for a sound philosophical explanation of most phenomena, and when apparent difficulties are encountered, a closer examination and our consequent increased knowledge, will undoubtedly overcome them all, as has been the case in the mechanical theory of heat. As heat is only a mode of motion of matter, and as heat is convertible into force, force is another mode of motion of matter.

I protest then against the metaphysical sense given by Professor WALLING to the expression "potential energy," and maintain that its rational meaning is, as suggested above, simply the stored up, or latent motion of matter, either molecular or as a mass. I maintain that the primary cause of all force or motion of matter is gravitation, which once caused nebular matter to coalesce in diverse centers of gravity, and so originated planetary systems, the enormous motion of great masses of matter being changed at the centre of attraction (the sun) into molecular motion (caloric). This molecular motion is now radiating back into space, by means of vibrations of enormous velocities (light and heat); and on the surface of our planet, we may easily trace all motion back to the power of this (as it were) reflected gravitation (the sun beam). Surely without this agency there would exist on our earth no motion nor life, which latter is nothing but motion derived from very complex chemical and thermic energies.

We are thus driven to the conclusion that all the diverse forces which surround us, and to which we owe our existence, are nothing but gravitation in disguise. And as in gravitation we find the origin of all force, and gravitation without matter is inconceivable, so force without matter is inconceivable.

Professor WALLING agrees that anyhow force never can manifest itself to him but by motion of matter; if he accepts this convertibility of motion into heat and *vice versa*, and rejects as he ought to, the old hypothesis of a caloric fluid, independent from matter, he cannot well maintain the existence of a still more subtle agent force—independent from matter, which he certainly will not consider as an imponderable ethereal fluid, but must suppose to be still more subtile, a spiritual agency. Such a theory would settle the foundation of mechanical science upon metaphysics and spiritualism.

P. H. VAN DER WEYDE, M. D.

New York, September 20, 1869.

[I have received from Dr. R. P. STEVENS, whose knowledge of the district in question is unsurpassed, the following important note.—H. W.]

Prof. WURTZ, *Chemical Editor* GAS LIGHT JOURNAL.

Sir: I see going the round of all the papers, an article copied from the Buffalo *Advertiser*, of the discovery of a bed of bituminous, cannel, or other coal, found in Wyoming county in this state, on the Little Buffalo Creek.

This so called discovery will doubtless turn out to be a misapprehension of geological facts. The black "Marcellus shale" of the New York system of rocks, is often so highly bituminous as to burn in the fire, and give off some blaze. It is frequently mistaken for coal, and has been for generations past. So also are black shales still further south in this state, and higher in the geological series; viz., the Genesee slate.

It was settled by the geological survey of New York, that there were no true coal-bearing slates within its bounds. All subsequent observations have proved the truthfulness of this conclusion.

When we read of coal on Lake Erie, on Buffalo Creek, in Gennesee county, in Onondaga county, in Steuben county, or in the Catskill Mountains, or along the Walkill or Hudson, we may safely pronounce the statement as untrustworthy, and not worthy of refutation, except that credulous persons might be thus stimulated to rash enterprises, and foolish expenditure of money.

R. P. STEVENS.

ON THE GRAHAMITE OF WEST VIRGINIA, AND THE NEW COLORADO RESINOID.

Read, with Experimental Illustrations, to the AMERICAN ASSOCIATION, at Salem, Mass., August, 1869.

By HENRY WURTZ, of New York.

It is now nearly five years since my attention was first called to this remarkable mineral. I at once recognized the scientific interest that attaches to it, and have always earnestly desired to carry out some systematic and thorough chemical investigations into its nature and relations; a desire so far frustrated to a certain extent. Pending, however, renewed efforts which I am making, to accomplish complete elementary analyses of the constituents of grahamite, as discovered by me; I think it my duty to communicate, for the first time, the full results of my former investigations.

Previous to 1865, the existence was frequently reported, and alluded to, in the public prints, of an extraordinary mineral formation on a branch of Hughes River, Ritchie county, West Virginia. It was sometimes called "Ritchie Coal," "Ritchie Asphaltum," "Crystallized (!) Petroleum" etc., etc. GESNER and others claimed it as identical with albertite, which they called an asphaltum (GESNER *On Coal Oils, Petroleum, Etc., p.* 27).

The eminent geologist, Professor LESLEY, was the first to introduce its existence to the general knowledge of the scientific world, which he did in a communication to the AMERICAN ACADEMY in Philadelphia (in 1864 I believe); not having himself visited the locality, however. His opinion, founded chiefly on inspection of hand samples, was that the material was an "inspissated petroleum," or say, *a mineral pitch*. The results of my own examinations of some samples, made in January 1855, did not enable me to concur in this view, and I projected a visit to the locality, which I succeeded in carrying out in the ensuing summer. It was then accessible but by a very rough bridle path of 15 miles, but now as I am told a branch railroad is completed from Cairo Station on the N. W. Virginia Rail Road.

The enclosing rocks are the ordinary blue sandstones and shales of the carboniferous, dipping generally about 15° or 17° N. W., in places nearly horizontal. The mineral occupies a vertical *dike-fissure*, it may be a shrinkage fissure, whose course is N. 76° to 80° E. A deep and narrow ravine cuts down deep into it, in the bottom of which some openings had well exposed the structure of the dike, which is obviously one of injection. My notes taken on the spot say, in substance:

"The structure shows four distinct, though somewhat irregular, divisional planes, having a general parallelism with the walls. Next to the walls the structure of the mineral is coarsely granular, with an irregularly cuboidal jointed cleavage, very lustrous on the cleavage surfaces; that in immediate contact with the walls usually adhering thereto very tenaciously, as if *fused* fast to the granular sandstone.

"Next these two outside layers, which are very irregular and from 2 or 3 inches or more in thickness, is found, on each side of the vein, a layer averaging from fifteen to sixteen inches in thickness, which is composed of a variety highly columnar in structure and very lustrous in fracture, the columns being long, and, at this place, at right angles to the walls. It is this variety that was given to Professor LESLEY; as would appear from his description. Finally, in the center of the vein; varying in thickness, but averaging about eighteen inches; is a mass differing greatly in aspect from the rest, being more compact and massive, much less lustrous in fracture, and with the columnar structure much less developed, in places not at all. The fracture and lustre of this portion of the vein are clearly *resinoid* in character.

"It is very remarkable that this curious dike-structure has heretofore escaped detection. Professor LESLEY, whose information however was derived at second hand, says that the mineral has 'not the slightest appearance of layers, but the aspect of complete uniformity and homogeneity.'

"The general aspect of the mass, as well as all the results of a minute examination of the accompanying phenomena, lead irresistibly to the conclusion that we have here a fissure which has been filled by an exudation, in a pasty condition, of a resinoid substance derived from, or formed by some metamorphosis of, unknown fossil matter contained in deep-seated strata intersected by the fissure or dike. It is not necessary to suppose a degree of fluidity greater than that of semi-fused pitch, or inspissated tar. Such a soft *doughy* mass, though flowing but slowly, would *in time* be forced by a very moderate pressure into every portion and into every crevice of the fissure. The peculiar structure described is such as would result from the fissuring of a fused or semi-fused viscous mass by the refrigeration produced by contact with the cold, and it may be wet, walls of the fissure; the outside granular layers being due to rapid cooling, and the columnar fracturing at right angles (or nearly so) to the walls (as, for example, in the case of a dike of columnar basalt) to a more gradual reduction of temperature, connected, without doubt, with the well known tendency of such materials as are susceptible of the vitreous or viscous fusion, to assume in time a concretionary or nodular structure. This tendency is strongly apparent in the brilliant variety, having produced multitudes of those curious markings on fissured surfaces which were mistaken in the case of the albertite for *fossil impressions*. The transverse columnar structure is called by LESLEY 'pencil cleavage.'

"Towards the extremities of the outcrop, where the sheet of mineral is thinner, this penicillate structure extends throughout the mass.

"The idea that this material was ever in the condition of fluid petroleum, is visionary and groundless, there being the strongest reasons why it could never have been more fluid than a very thick semi-fluid pitch; of which reasons one of the most obvious is the entire absence of any penetration of the material into the surrounding porous sandstones. Also, no such substance as this, or any thing approximating to it chemically, was ever known to be formed, or to have been formed, by the oxidation and inspissation of petroleum; and the formation from liquid petroleum, in such a fissure, to the depth of hundreds of feet, by any process of oxidation from the surface, of a mass so uniform as this, is an idea which I believe will receive but meagre acceptation among those chemists whose minds are free from the trammels of pet hypotheses.

"I will add, that I have yet to learn of the existence of *any* products (now forming) of oxidation or 'inspissation' (whatever that may be) of West Virginia petroleum.

"In sinking a small shaft here, 28 feet deep, Mr. J. CARVILLE STOVIN, the engineer in charge at the time, found a detached fragment three and a half feet long of the north wall of the dike, imbedded in the mineral twenty-four inches distant from said wall, and twenty-nine inches vertically below the *hiatus* in the wall, marking its point of detachment; while exact measurements, both of itself and of the cavity left (on removing the mineral which occupied its original space) showed that it had become entirely inverted in position during its descent. The pitch-like semi-fluidity, which I have contended for, is here strongly illustrated, by the small depth of descent of this mass of quartzose sandstone, through a material whose density could not have been half of its own; while its distance from the wall and inverted position suggest that at the time of its detachment the dough-like mass was still rising, or in some sort of motion at least, in the dike-fissure.

"I myself observed similar *horses* of the wall rock, of small size, similarly imbedded in the mineral, at several points."

The density of a mass of the mineral was found to be 1.145. The horizontal extent of visible outcrop actually measured by me was 530 fathoms, thinned out at east end to 30 inches, and at west end to 8 inches; but as these points were at least 70 to 80 fathoms vertically higher than the bottom of the ravine, the width (averaging about 50 inches) at the latter depth points to a rapid widening of the fissure in descent. Allowing a uniform width of 40 inches at the level of the bottom of the ravine with the longitudinal extent measured, and with the above density; each fathom in depth at this level would contain 2000 tons. The depth to which it may extend is of course wholly unknown; but if the view I have provisionally adopted of the way in which this dike has originated be correct, it follows that it must widen in depth. This view I I would present as follows:

By the action of heat upon strata of rock containing fossil matter, and the pasty fusion of this fossil substance, and the partial gasefaction of itself and its contained water, with the uncontrollable expansion resulting therefrom, there has been opened a fissure through which the doughy mass, puffed up by bubbles of steam and other gases, escaped to the surface, or at least near enough to the surface to relieve the tension, and allow the steam and gases to escape gradually through the porous sandstone.

This hypothesis of mine seems the only one which reconciles an important difficulty besetting the other hypothesis (namely, that which creates a fissure originally filled with liquid petroleum, that has undergone "inspissation" from surface agencies); that is, the interference of water, which must necessarily have filled a pre-existent fissure, and opposed an obstacle to the subsequent infiltration of another fluid, at least if the latter were impelled by gravity alone. The supposition that the fissure itself was formed simultaneously with, and by, a fluid mass, containing within itself its own elastic expansive force; escapes this difficulty. I may also point out that it is not necessary to suppose that the *heat* which produced this expansive force was the central heat of the earth; for it is more probable that both the steam or gases, and the heat which expanded them, arose from a spontaneous decomposition (of the nature of fermentation) in the bed of fossil matter from which the grahamite exuded.

The view will occur that these original beds of fossil matter are beds of bituminous coal, as such coals without doubt underlie the locality. The only present support for such an idea, so far as I know, is the extraordinary statement of LESLEY, made on the oral authority of Prof. HALL (see LESLEY's Manual of Coal and its Topography, p. 165,) of a "leader of coal" proceeding from a coal bed downwards into a limestone quarry, and there spreading out into a layer.

CHEMICAL AND MINERALOGICAL CHARACTERS.

This mineral is, in its actual identity or individuality, not only new, but cannot even be *classed* with certainty as yet, with any other mineral substance heretofore known and investigated by chemists. It is in its behavior with solvents especially, as well as with some other chemical agents, that those pecularities are found, which establish it as a substance *sui generis*.

To the action of acids, alkalies and oxidating agents generally, it is quite indifferent. Concentrated boiling nitric and muriatic acids, and even *aqua regia*, have no action whatever upon it; nor has boiling sulphuric acid, if somewhat diluted. Oil of vitriol, however, even in the cold, forms a brown solution. The most concentrated caustic alkaline solutions are totally without action upon it.

Alcohol does not dissolve a trace of it. Naphtha, benzole and ether dissolve part of it; oil of turpentine gradually swells it up into a tar-like magma, and then dissolves most of it; but its true solvents are *chloroform* and *sulphuret of carbon*, each of which apparently dissolves nearly the whole mass of the mineral with great rapidity, leaving nothing except the mineral matter (ash,—by analysis, about two per cent.,) and some small proportion of coaly matter.

When heated in the open air it endures a temperature far above that of the fusing point of asphalts (which is usually below, and never much above, the boiling point of water) without change; but when heated above 400° F. it begins to decrepitate, smoke and soften, behaving very much like a highly caking coal.

The vapor given off under these circumstances I have found to be chiefly water. There is little or no smell, such as all asphalts give out when heated, and I may remark that no odor is given out when this mineral is broken, rubbed or scraped, or even from a mass of it lying in hot sunshine. The argument deducible herefrom, that it never could have been produced by the atmospheric oxidation of any other substance, and more particularly of petroleum, will be appreciated by chemists, at least. If the heat is now raised still higher, empyreumatic vapors appear and indications of pasty fusion in the central and lower portions of the mass though not upon the upper surface; the fact being that under ordinary atmospheric pressure the material is incapable of fusion without decomposition; but that under a very slightly increased pressure, even such as is developed by its own pasty cohesion at the caking temperature, a pitchy semi-fusion takes place. While in this condition the resinoid (or viscous) character of the material may be made strongly apparent, for by a little dexterous manipulation these central semi-fused portions of the mass may be drawn out into long, delicate threads, like semi-fused glass, sugar, or sealing wax. To my surprise I have found that by exceedingly careful manipulation with albertite, I could thread it out in the same way, though with far greater difficulty than with grahamite.

From the above it is clear that the West Virginia mineral can neither be identified, nor even classed, with coal, asphaltum, or albertite; and I have hence thought it both admissible and just to perpetuate in connection with it the name of the gentlemen who have been so energetic in promoting a public knowledge of this new material; by conferring upon it the new name *grahamite*.

The above statements were in substance comprehended in a pamphlet printed and privately circulated in the fall of 1865.* It remains for me to present as concisely as possible, some of the results of my subsequent laboratory work upon grahamite, which, as before intimated, I am now preparing to extend further.

The most important development made up to this time, has been the decomposition of grahamite (at least 95 per cent. of it) into two distinct resinoid substances, to which I have given, for reasons that will appear, the names *Viscosine* and *Irisine*. These are separated from each other by the action of solvents, viscosine being readily soluble in ether and petroleum-naphtha. The crude irisine remaining after the action of one of these solvents may then be extracted pure by one of its solvents, among which are *chloroform*, *bisulphide of carbon*, *oil of turpentine* and *benzole*. The dull compact core of the grahamite-dike contains a much smaller proportion of viscosine than the lustrous penicillate portions nearer the walls.

Ultimate organic analyses of grahamite, as a whole, have been made; but for several reasons, especially because of my observation of its mixed nature, I attach no importance to them, and shall not quote them. Analyses of pure viscosine and pure irisine, however, would be of high interest, and will in due time be made.

PROPERTIES OF VICOSINE.

The liquid solutions formed by the action of a solvent of viscosine on the crude mineral possess a powerful olive-green fluorescence, exactly like that of many crude petroleums. The most lustrous samples of grahamite yield as much as 20 per cent. Dense solutions are as viscous as a thick syrup of glucose or a strong liquid glue.

Solid Viscosine.—This is a substance of a very peculiar combination of physical and chemical characters. Though acquiring, by semifusion, a ductility and viscosity comparable to that of shellac and some others of the true resins, it is wholly separated from this class of substances by its chemical properties. Thus the most concentrated alkalies, even as fused hydrates, are wholly without action on it. Sodium remains indefinitely bright in a solution of viscosine in a liquid hydrocarbon, benzole for example; whence it appears to be a *hydrocarbon*, and, I believe, the first example of a hydrocarbon possessing a resinoid viscosity. Probably its most peculiar conjunction of properties is that of its passage, within very narrow limits of temperature or permeation by a solvent, to a solid form in which it is excessively brittle and fragile. On solidification from fusion its surface is extremely brilliant. When heated, viscosine melts readily to a thin liquid and finally distils partially unchanged. In a current of superheated steam it may be distilled over without change, except a darkening in color. The crude oil obtained by distilling grahamite contains much of it, especially when superheated steam is used. Freshly obtained, by evaporation of its etherial solution, it has a distinct balsamic odor, which after some time departs. In the mass it is brown, in powder buff-color, in thin layers nearly colorless.

I believe that this viscous hydrocarbon occurs in crude petroleums, and I have obtained a product from gas-tar approaching closely to it.

IRISINE

Is inodorous; infusible without decomposition (except probably under heavy pressure); black in the mass, and pure dark brown in powder. When permeated with a small quantity of a solvent, it has no viscosity, but is rather gelatinous and elastic, or slightly india-rubber-like in consistence, and shrinks enormously, and cracks accordingly, in drying.

It forms in solution in turpentine, chloroform, benzole, etc., very fine lustrous varnishes, which have the extraordinary property, when somewhat thinned, of always drying on polished surfaces to a *brilliant iridescence*, the colors having a sort of metallic depth and body only to be compared with those produced by heat on polished steel, while much brighter than the latter. This property has led me to confer upon this characteristic and main constituent of grahamite the special name *irisine*. There is much more in it than the mere phenomenon of thin films. I should suggest an extraordinarily *low* refractive index for irisine, were this not difficult to reconcile with the fact I have observed that the presence of the *minutest quantity* of most other substances (viscosine excepted) in the solution impairs or wholly destroys the colors. It seems to me rather to be intimately connected with the peculiar *pure deep brown color* of irisine (combined, it may be, with a low

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* An unsatisfactory account (to me) of this pamphlet was given in the *Am. Journal of Science* xlii, 420; and DANA, in the latest edition of his Mineralogy, has adopted my name grahamite, although he still appears to take the view, which I trusted I had overthrown, regarding the nature of the material, that it is "supposed to be like the albertite, an inspissated and oxygenated petroleum" (DANA's Mineralogy, page 758).

Since the date of the publication of the above pamphlet, a paper was presented to the AMERICAN PHILOSOPHICAL SOCIETY (see its *Proceedings* for July 1868, page 457) by Prof. S. F. PECKHAM, in which, without knowledge of the above, views are taken singularly approximate to those I have expressed regarding the mode of origin of minerals of this class. From recent correspondence with Prof. PECKHAM I learn that he will soon publish a paper, in which he himself points out this coincidence.—H. W.

index of refraction), and I am strongly desirous of assistence in the matter from some gentleman experienced in optical researches. Of such I should first of all ask whether the formation, in such a thin brown transparent film, of innumerabled excessively minute *fissures*, seen against a specular background, could lead to the phenomena described? I refer of course to the property of irisine, above pointed out, of shrinkage, indesication from the colloid condition. This hypothesis would accord with the observation of the destruction of the color by small quantities of fatty and other substances, acting by alteration of the peculiar condition of *cousistence* of irisine. Experiments to test this could doubtless be devised.

Another characteristic of irisine is that it is instantaneously altered and precipitated (from its solution) as an *insoluble modification*, by mere contact with a drop of sulphuric acid, and with some other agents; becoming thereby *insoluble in all menstrua* yet tried. It may thus be prepared in a state of purity for analysis; and moreover, as *animal charcoal* is one of the agents which have this power of modifying and precipitating irisine, while it has no action (except a decolorizing one) upon solutions of viscosine, we have also here a means of obtaining the latter perfectly free from irisine for the same purpose.

To the above strongly marked peculiarities of irisine, may be added its as yet almost unique conjunction of the properties of high solubility (when in the soluble modification) in so many solvents, with high infusibility. The conjecture is offered that bituminous coals contain the insoluble modification of irisine or of substances of its class as yet unknown. In this connection I would recall that petroleums, and even distilled coals oil contain substances precipitated by acids, but not yet investigated.

As to the *composition* of irisine, we have as yet no analysis. Experiments with sodium, which in time precipitates it completely from its solutions, would seem to indicate an oxygenated body; but as minute quantities of alkalies as well as acids, convert it into its insoluble form, this is inconclusive. In organic combustions, great difficulty will be found, as its coke swells up and is excessively hard of combustion. I propose introducing it, however, into the combustion tube as a chloroform solution, in a sealed bulb, which may then be broken and the solution absorbed by the oxide of copper, the chloroform being of course removed before the combustion as vapors.

The Insoluble Residue of Grahamite.

This, which is very small in quantity, as left by exhaustion with chloroform, was kindly examined for me with the microscope by Dr. JOHN TORREY. He reported that there was no trace of organic structure and that it appeared to be mainly quartz sand.

Comparisons With Other Substances.

From all such, grahamite readily separates itself. Most so-called *asphalts* (a term I should wish to confine to products of subaerial alteration of petroleums) differ greatly in their relations to solvents. Ether, for example, as stated by BOUSSINGAULT, DUMAS, and others, usually dissolves most of these. Still I believe that I have detected both of my new substances viscosine and irisine, in some asphalts that I have examined.

Also, the benzole solution of albertite, comprising usually about 20 per cent. of the mineral, I find to contain viscosine, irisiue, and another substance unknown as yet; 80 per cent., however of the albertite, is insoluble under ordinary circumstances, and may possibly, though not probably, be *insoluble* irisine, or a homologue thereof. I propose further investigations into this matter, and especially analyses of the proximate constituents of the albertite as obtained by the agencies of solvents, the only analyses, it seems to me, likely to be of much value.

BOUSSINGAULT'S *Coxitambite* comes no nearer; nor STERRY HUNT'S bituminous veins; nor "*Zopissa*" (which latter I found to be a greasy variety of asphalt).

THE COLORADO DIKE.

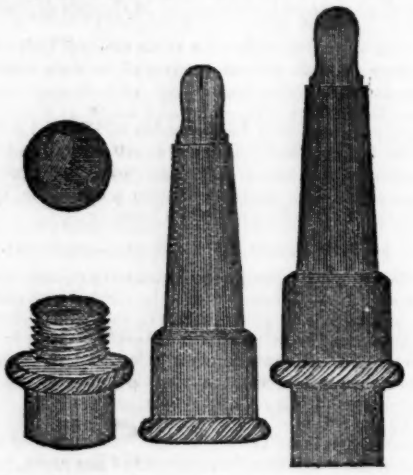
Four or five years since we began to hear of a curious formation in Colorado, believed to be albertite, which it very remarkably resembles in aspect. I was fortunate enough to obtain through kindness of Dr. NEWBERRY, from the collection of the Columbia College School of Mines, a sufficient sample of an authentic specimen of the Colorado mineral to enable me to determine the surprising fact, now announced by me for the first time, that this is also *grahamite*, chemically almost identical with that of the West Virginia dike.

Its fracture is brilliant, but not so much so as albertite, and it is not penicillate like the glossy variety of grahamite. It contains scarcely any mineral impurity, dissolving wholly, without appreciable sediment, in chloroform, benzole, and oil of turpentine. Ether extracts about the same proportion as from glossy grahamite, with the same green fluorescence, and leaves, on evaporation, viscosine, identical in every way with that of grahamite. The residue from ether dissolves wholly in benzole, and gives all the reactions of irisine but is lighter in color, and the iridescences obtained are not so strong. Sulphuric acid wholly precipitates this Colorado irisine.

It may of course be anticipated that this highly characteristic species grahamite will be discovered elsewhere, two localities being already known, separated by the width of half the continent.

Spring Valve Gas Burner.

The art of manufacturing illuminating gas and distributing it to consumers is one thing; the art of burning gas economically is quite another matter. If the pressure of gas in the street mains and service pipes is above 2-10ths of an inch water pressure, the gas will be emitted at the burner too rapidly to yield the full effects of combustion and illumination, and as the pressure increases so does the loss to the consumer, ranging from 10 per cent. to 70, and even 100 per cent.



The patent valve gas burner illustrated herewith is designed to avoid this loss by means of a spring valve, which closes and checks the flow when the pressure of gas is too high, to burn economically, and opens to give free passage to it. The cuts exhibit a burner complete, also one taken apart showing the perforated septum or plug, having its little metallic spring valve on the inner side, which closes or opens the little passage in the plug as the pressure varies. This causes the flame to burn in a regular and uniform manner, and avoids flickering and blowing, besides economizing the gas,

It is especially adapted to domestic use in private houses, stores, shops, factories, public buildings, street lamps, etc. It also has an indestructible lava tip.

These burners are quite popular, and are becoming extensively used. For further information apply to or address Messrs. Avery & Co., Springfield, Mass., who manufacture and sell the same, also for sale at Archer & Pancost, 70 Wooster st., New York City. Their advertisment may be found in another column.

Society of Practical Engineering.

This Society held its regular monthly meeting on the evening of Wednesday, the 15th of September, in the Cooper Institute Building, the President, James A. Whitney, being chairman. The regular subject of the evening was then taken, up "Water-meters, their Uses and Construction" on which an able and interesting paper was read by Dr. A. W. Hall, of New York city.

After referring to the engineering skill of the ancients as shown in the remains of aquaducts and water works for the supply of cities, the writer proceeded to examine the modern means of supplying cities, and especially the different devices for apportioning the supply among the inhabitants. Hundreds of patents had been obtained in the old world for different water-meters, while no less than one hundred and thirty had been issued in this country. He said by actual count, fifty odd firms and persons were now working on water-meters in New York alone, and that in the same city about 1,000 piston-meters were in use in factories, but none in dwellings, as they were too expensive except for large shops where water was extensively used. He classed all the systems of meters in use under five heads, namely, piston, diaphragm, spiral, rotary and dumping meters, and pointed out the defects and advantages of each class; piston-meters he regarded as liable to the objection of friction and danger of being fouled by grit, or sedement in the water, and if loose enough to avoid this they allow water to pass the pistons without moving the counting device. Without the water is free from foreign substances and the machinery made with great accuracy there is no certainty of a correct record of the water passing the pistons.

With regard to rotary meters, it was said that one difficulty in making tight the rotating piston, the same that has destroyed the utility of rotary steam engines, must always prevent their adoption as reliable means of measuring liquids. The writer also mentioning that almost any one of the hundreds of rotary engines that have been devised, might be converted into a water-meter by simply passing water into it instead of steam, and providing it with a suitable registering device. Diaphragm-meters were conceded to possess the advantages of freedom from friction and non-liability to derangement from choking, etc., but the rapid deterioration of the material composing the diaphgram has thus far stood in the way of practical success. The screw-meters from the tendency of any defect of the indicating appliances to interfere with the uniform movement of the screw, and the dumping-meters, from their availability only upon the upper floors of buildings, were considered as not at all adapted to the present wants of the city public. In addition to certain essentials in the structure of a meter capable of meeting these wants, such meter must be sold at a price much less than those now in the market. The price of the cheapest meter now sold is thirty-five dollars, American currency, for a one inch meter, but the one most extensively used costs more than twice as much. To supply New York city at this rate would involve an expense of from six to ten thousand dollors; such an expenditure would be out of the question. A meter to meet with favor from the people must be sold at eight to ten dollars, so that the saving in the water rate, may in two or three years, pay for the apparatus.

The demand for an inexpensive meter is destined to increase, for in addition to the now ordinary water supply to dwellings, factories, etc., the plan of conveying water in pipes for the propulsion of light machinery will hereafter be more extensively put in practice. A joint stock company in New Haven, Ct., propose in this manner to convey water to the houses of artisans and small mannfacturers. To measure the water thus supplied will require in the present instance, in the neighborhood of ten thousand meters.

The writer then took up the condition of proportionate meters, so-called, because they operate by measuring a definite proportion of the water passing through the meter, the proportion forming an index to the entire quantity. In theory very plausible, this class of meters had proved one of the most difficult of all to bring into reliable shape, the writer mentioning an instance of one proprietor, who after expending upwards of ten thousand pounds in fruitless experiments, gave up the problem and turned his attention to piston meters. The writer stated that after several months of persistent effort, he had overcome the tendency to error from variations in the velocity and pressure of the water, which has hitherto destroyed the efficiency of this class of meters. He then proceeded to describe his invention, the operation of which might be explained in brief, as follows: On turning the faucet to permit the out-flow, the meter lifts two valves, from two water passages, through one of which the greater portion, say, ninety-nine per cent. passes to the faucet, while the remainder, one per cent. passes to a small dumping-meter, the operation of which turns the index of the attached registering device. Variations in the relative proportions of the quantities of water passing through the two passages, are prevented by a simple arrangement of parts by which the water is caused to exert a back pressure upon the smaller valve, in such manner as to obviate the opening of the smaller passage to an undue extent. The writer also exhibited a proportionate faucet embodying the same principle. In this the two water passages are formed in the plug of the faucet and that from the smaller pas-age, after actuating the register in the manner previously mentioned, flows through a suitably arranged pipe to the mouth of the faucet, and flows out with the rest, so that no water is wasted. This apparatus may be very cheaply made, and is designed for use in the crowded tenements inhabited by the humbler classes in cities.

A report from Joseph G. Lyman, chairman of a Committee on Meters, appointed at previous meeting, was read, stating that a large number of meters had been tested before the Committee, and giving the general results ascertained. Owing to the number of very recent improvements not fully considered, it was not thought best to report in full until the subject was more fully investigated.

Mr. Hawley, of Albany, N. Y., exhibited a very ingenious device on the diaphragm principle. He claimed that it had been tested for ten years with perfect satisfaction. Mr. Hicks of New York, explained his new piston-meter, wherein the pistons serve as water valves. There is no doubt but that this is one

of the best, and decidedly the cheapest piston-meters in use. The Cochrane meter was then explained by the inventor, by which water is dumped in an air-tight chamber, and by air pressure forced to the upper stories of the buildings.

The Chair having announced the next meeting of the Society for the second Wednesday of October, and the subject of Railroad Accidents as the paper to be read, the meeting adjourned.

Gas for Lighthouses.

A series of letters and reports sent to the Commissioners of Lighthouses and the Board of Trade has resulted in a request being made to Professor Tyndall, by the latter body, that he would report upon the proposal to substitute gas for oil as an illuminating power for lighthouses, as illustrated in the lighthouses of Howth Baily and Wicklow Head. Various experiments were made at Howth Baily, and Professor Tyndall says that the superiority of the gas over the oil flame is rendered very conspicuous by these experiments. The 28-jet burner possesses 2¼ times, the 48 jet burner 4¼ times, the 68-jet burner 7¼ times, the 88-jet burner 9¾ times, and the 108-jet burner 13 times the illuminating power of the four-wick flame. The oil lamp with which the gas flame was compared was the most perfect one employed by the Commissioners of Irish Lights. Further experiments were also made, and it appeared that the whole of the gas-lighting apparatus was entirely under the control of the keeper, and that no damage was likely to arise faom it. The 28 jet gas burner, when seen from a position some miles off, appeared to be very nearly upon an equality with the oil lamps, but when muffled to represent a fog it had a slight advantage. Of course with the brighter jet-burners a great improvement was apparent, and before the 108-jet burner the oil lamp grew quite pale. By the adoption of a system of gas-lighting a great saving in cost would be effected; but such a system would not be possible on rock lighthouses. Professor Tyndall recommends the encouragement of this system of illumination in Ireland. He was assisted in his investigations by Mr. Valentin, Captain Roberts, and Mr. Wigham.—*Brit. Trade Journal.*

Lighting Mines With Gas.

In improving the method of lighting mines, Messrs. M. Wilkin and J. Clark, of Paddington, propose, says the *Mining Journal*, to use lamps burning gas, oil or other illuminating materials, but instead of allowing the lamps to draw the air proper for their combustion from that surrounding them, they furnish them with air propelled from a source, at the bottom or top of the shaft; they convey the air to supply the combustion in air-tight tubes to the interior of said lamps.

They supply a greater quantity of air to said lamps than is necessary for the combustion of the gas or other illuminating material, and the overplus they cause to blow gently out by escape-valves or covers near the top of the said lamps, thereby preventing the entrance of foul air or air which has become mixed with fire-damp. By preferance, they glaze the lamps about half their height with glass, the upper half they prefer to make of sheet metal to withstand the heat. They furnish dampers to the lamps, so constructed that when the proper supply and pressure of air is obtained, the damper is elevated, but if the supply of air is withheld, the damper will descend or collapse, and extinguish the light, or turn off the supply of gas according to the kind of lamp used. The said dampers may be fitted in connection with the escape-valve above referred to. When gas lamps are used, the gas is produced, and conveyed in pipes in the usual way. The air is propelled through the air-tight tubes, above refered to, by any well understood method, such as by fans, air-pumps, steam-jet, etc. In lighting the lamps, they propose to use the safety matches, such as those manufactused by Bryant & May. After the match is inserted into the lamp by the escape-valve refered to above, it is struck, and the lamp is lighted. They furnish the lamps with tubes, into which the lighted match is thrust, and thereby extinguished before it is withdrawn.

The dark spots on the Sun are not really dark—they are only apparently so by comparison. They are supposed to be aggregations of gaseous matter less highly heated, and consequently less luminous than other portions of the sun's luminous atmosphere. These spots are dark, when seen on the sun's surface, just as the flame of a candle, or any other, even the brightest artificial light is dark when held between the observer and the sun. The spots which are dark while in the center of the sun's disk, become red, when seen upon the edges of that luminary during a total eclipse.

Correspondence.

[Correspondents in all cases should sign their communications with their names and address in full, not necessarily for publication, but as a guarantee of good faith.—Eds.]

A Visit to Madison Gas Works.

Messrs. Editors: Desiring a breath of fresh air outside of our city not impregnated with gas, at such intervals as has been our fortune during the past year, I recently took a trip as far south as Madison in this State. Beautifully situated on the Ohio, in a basin entirely surrounded by high hills, I found it a very pleasant place to pass the few hours of leisure that could be spared from business.

R. McKim, Esq., who supplies the Indianapolis, Terre Haute, and a number of other Gas Light and Coke Companies with the best quality of Youghiogheny coal in the market, hitched up his team and took me out on the hills in the rear of the city, by a fine turnpike winding up along the hill side, through the primeval forests still left standing, in all their romantic beauty; on one side towering far above our heads in solemn grandeur, on the other, we riding above the tops of the lofty trees, which tossed and rolled in the ravines, and on the hill sides far beneath us, until we arrived at the grounds of Hanover College, a Presbyterian institution, the scholars at that time apparently, enjoying a vacation.

There a most beautiful view of the Ohio River, may be had. As far down as the eye could reach might be seen the course of this beautiful winding stream, with a steamer urging its way slowly but surely against the current; on the opposite shore were the dark green hills of what was the "noble state of Kentucky," many of whose people have since so sadly degenerated; while far above was the city of Madison, rested at the foot of the hills that skirted the northern bank of the river. Apparently a more healthy location or beautiful view of nature in all her variety of earth, sky, and water, of hill and plain can rarely be seen, and was particularly enjoyed by one who has been for so long a time a denizen of the cruel Prairie. We people of the plain, however, cannot find fault that we are deprived of this beauty, for what we lose in that particular, is fully made up in the richness of the soil a kind Providence has given us as a compensation for this deprivation. Our luxuriant harvests of wheat, corn, hay, all the varied products of the farm, fully compensate for the beautiful scenery and poor soil of that region of the State.

The gas works at Madison, under the charge of President and Superintendent Todd, did not quite come up to my expectations, after reading his description of what he had done. He is making important changes, which will put them in excellent condition for all the wants of the city for years to come. When a gas works is in a transition state it is not a very inviting place for strangers to examine, who do not know all that is intended to be done. When the alterations are finished we doubt not it will look like another place.

The city of Madison has the appearance of being full grown; there is very little more room to expand, unless they back up on the hills in the rear. We think however that by a more liberal policy on the part of the gas company and the extension of the mains, the number of consumers might be considerably increased, and the pockets of the stockholders thereby benefitted; but we suppose they understand their own business best.

There is little improvement going on in the city, very few or no new buildings are being erected; only some slight alterations were noticed; trade appeared to be extremely dull. I regretted much that friend Todd was absent, as a desire to form an acquaintance with the gas men of the state, was one of the objects of our visit. One great end of the "convention" that died in embryo was to bring together gas men, that they might know and appreciate one another; compare notes as to past experiences and contemplated changes, and so gain some knowledge of the practice of others in the conduct of their own works, which we doubt not would have resulted favorably to the interest of all concerned.

The mode of ingress and egress to and from Madison by rail is a triumph of engineering skill; a cut is made through solid rock some hundred feet; the cars come down by their own gravity, regulated only by the breaks of the several cars, and when nearly down they are eased up; away whirl the cars at a tremenduous rate around the curve at the base into the depot. Formerly the ascent and descent was made by an engine with a cog arrangement, but this was found too slow, and has since been displaced by the use of an immensely heavy and powerful engine which works its way rapidly up the inclined plane; a number of accidents have occurred, but the present method has given the most security of any that has been adopted, and we have heard of no accident at this place for years.

At Columbus and Franklin, two thriving towns on the rail road between Indianapolis and Madison, gas works are being erected, at a cost of twenty-two thousand dollars each; the same contractor is erecting both works. We observed the trenches for laying mains were dug at both places at different points.

Henry Stacey Esq. Engineer of the Indianapolis Gas Works, has been selected to supervise the works while in process of erection, on the part of the company, to see that the contract is complied with.

Very great changes are taking place at the Indianapolis Gas Works, under the able superintendance of Henry Stacey, Esq., Engineer. Since I was last there they have obtained from the American Meter company a fine large station meter, and during the present summer have introduced an exhauster with all the latest improvements. In the old retort house ten benches of threes, iron retorts, have been taken down, and in their place have been put up eight benches of fives, clay retorts. In the new addition to these works, five benches of fives, clay retorts, have been constructed, making altogether, with those already in use twenty-one benches of fives, clay retorts, or one hundred and five retorts, 12 by 20 by 9 feet.

There is in process of erection a new purifying house. The purifyers will be 12 by 16 with five tiers of trays in each box. Dry center valve with ten inch connections.

The condensers will be five columns on the annular plan, 30 inches in diameter 12 feet high, also a column washer 42 inches in diameter 12 feet high, with three divisions of boulders, on the same principle as those already in use. Perhaps a brief description of these may not be amiss; they were in operation when I visited these works about two years ago, although boulders were not then used; these have been in use over a year without changing and give every satisfaction.

The present washers consist of an oblong box with a partition in the center, descending nearly to the bottom, dividing the box into two parts; in these are arranged three tiers of percorated shelves or slats on which smooth boulders or paving stones are placed, eight inches deep; the water trickles down over these; the gas passes down through these three tiers into the water, under the partition and up through the three corresponding tiers of wet boulders on the other side; they seem to answer an admirable purpose, as the difference of temperature is plainly perceptible to the touch; the substitution of the circular for the oblong washer is merely on account of economy.

They will lay this year nine miles of mains, Robbins joint, thereby making an addition of some three hundred consumers and two hundred street lamps, with a total of twenty-one hundred consumers and one thousand street lamps this winter.

Messrs. President Fletcher, Secretary Van Laningham, and Engineer Stacey, I found to be lively young men, courteous, active and energetic, with whom I spent a very pleasant hour talking over gas matters.

I felt some curiosity in reference to the statements of Gas Inspector Fleming of that city, and was not surprised to find there was "great cry and little wool" in the whole transaction. Most of the changes were produced and introduced by the officers of the gas company and the members of Council, previous to the appointment of the inspector, whose main object was to get an office that would yield him a living, according to his own statement. In responce to the "lengthy com-

munication on Twilight, etc.," by Engineer Stacey, the history of it was simply this. The City Engineer asked Mr. Stacey for the time table under which the city lamps had been lighted previously, when he merely enclosed an almanac of the American Meter Company without note or comment.

This vexed question of furnishing gas to public lamps should only be done in one way, and that is by meter. Companies will not receive fair pay for the gas consumed, until the meter manufacturers get up a reliable one-light meter, suitable for the purpose, to be placed in every post; then the amount can be accurately determined, precisely as for private consumption; this plan will be perfectly just to the company and the public. The method of estimating the gas consumed by two or more meters is unjust to the company; and the worse method of charging so much per lamp per annum is liable to the same objection, The amount of gas used should be paid for at a stipulated price, whether it be much or little, and no more nor no less than the quantity consumed, ascertained by a scientifically constructed instrument, whose correctness can be tested as accurately as a standard bushel or any other measure of quantity.

In England they have one-light meters. I have, since my last, ascertained from a reliable source, that the *tank* of Cincinnati Gas Light Company leaked to such an extent, that the water in the tank was ten or twelve feet beneath curb.

Yours truly, R.

About Gas Meters.

Messrs. Editors: During a recent visit to a large gas manufactory, I remarked that the candle power, as recorded from *daily* observations was very high, namely, from 19 to 20 candles for a light produced by burning only four feet per hour, the standard rate for such determinations being (as is well known) five feet per hour.

The superintendent stated that he could not burn five feet per hour from his burner without its smoking, and invited me to test it for myself. We went to the photometer room, where I soon saw that he had been making a mistake in reading the meter, and that what he took for a rate of *four* feet was really a rate of six feet per hour.

At the works there are two test meters, one used for testing (burners, I will call it burner-meter) and the other used in connection with the photometer.

In both these meters the circle described by the quick hand corresponds to the delivery by the meter of one tenth of a cubic foot. But this circle on the burner meter is divided into sixty equal parts, each tenth division being numbered 1, 2, 3, 4, 5, or 6, while on the photometer meter it is divided into 100 parts, each tenth division being numbered 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100.

On the other burner meter the slow circle corresponds to 10 revolutions of the quick hand (one cubic foot), and is divided into 10 equal parts. But on the photometer meter this circle corresponds to 40 revolutions of the quick hand (four feet), and is divided into 40 equal parts, each tenth division being numbered, 1, 2, 3, or 4.

Upon the dial of the burner meter are these words, *hourly rate of consumption by observation of one minute*. This direction is correct, as will be apparant by supposing the quick hand to make one complete revolution a minute, then in one hour the meter will register 60 times 1-10th ft. 60 10th feet equal to 6 feet; therefore 1 6th, 4-6th, 3-6th, 2-6th, 1-6th, of a revolution per minute corresponds to a like proportion of 6 feet, that is 5, 4, 3, 2, or 1 foot per hour.

Upon the photometer meter also is the inscription, *hourly rate of consumption by observation of one minute*. This is evidently wrong, and the error above referred to was made by considering one revolution of the quick hand to correspond to 4 feet per hour, taking the figures from the slow circle.

Now this meter registers actual consumption, and the hourly rates must be obtained by calculation. Having met with a number of superintendents who were *puzzled* to reduce like readings to hourly rates, I may be pardoned for giving the following rules. *Take the state of the meter at the begining and end of an experiment*, the difference will give the consumption in thousandths of a foot; *divide the difference by the number of minutes, multiply the quotient by* 60, *and divide product by one thousand, this quotient will be the rate per hour.*

For example:—Suppose the state at the begining to be 1274, that is 12 on the slow circle and 74 on the quick. At the end of 15 minutes suppose it to be 2724, the hourly rate of consumption is found by the rule to be (2724–1274) .. 15x60 .. 1000.

```
2724
1274
----
15)125 0 — consumption for 15 minutes.
----
 83⅓  "  "  1 minute.
   60
----
1000)5000 —  "  "  1 hour.
----
   5 —  "  "  "  "  in feet.
```

(in thousandths of a foot)

Respectfully yours, T. E. S.

[We are sure many of our readers will gain reliable information, by perusing the above clear and comprehensive exposition of the gas meter. The writer is familiar with the subject, and we hope to often receive favors of a like nature.—Eds.]

Report of the Ironton (Ohio) Gas Company.

Messrs. Editors: I send you a condensed statement of the doings of the Ironton Gas Company since its organization, Febuary 9, 1867.

Capital stock $40,000; works erected by R. T, Coverdal, of Cincinnati, Ohio, at a cost of $34,000; went into operation September 7th, 1867, with one hundred private consumers and fifty-one public lamps.

Dividends declared January 1st, ten per cent., July 31st five per cent., leaving a surplus of two per cent. in the treasuary.

Coal carbonized during the seven months ending July 31st, 370,400 lbs. yielding 1,493,900 cubic feet of gas, fifty-two bls. tar (netting us $509.55), and one bushel coke sold for every two bushel coal used. During the last four months we have made gas but about twelve hours out of twenty-four; so at least one fourth of the coke consumed has been a loss. Cost of purifying in the months of January and February for lime $45.80; remaining five months, for lime $6.20; for grindstone dust (paid drayman) $1.20.

We now have one hundred and ninty private consumers and sixty-four public lamps. Are running a bench of threes iron, and have a bench of threes clay idle, and are about to commence the erection of a bench of fives clay for winter use. Gas $4.00 per 1000, with five per cent discount for prompt payment; public lamps $8.00 per 1000.

Respectfully, E. M.

[We publish this statement to give an idea of the way our Western friends operate small Gas Works, and the economical margin is shown. The item of purification by the novel use of "*grind stone dust*," it will be seen, is much reduced in cost, compared to the ordinary lime process.—Eds.]

The Teleiconograph an American Invention.

[We received the following letter from Mr. W. H. Edgerton, of Fort Wayne, Ind., wherein he claims to be the inventor of the instrument called "Teleiconograph." There can be no doubt that M. Revoil's invention was anticipated by Mr. Edgerton as early as 1862.—Eds.]

Fort Wayne, Ind., Sep. 20, 7869.

Messrs. Editors: In your issue of the 16th inst. I observed an article, copied from the London *Builder*, describing a new instrument called a "Telleiconograph," devised by one M. Revoil, a Frenchman.

I have a transit Theodolite made for me to order, by Messrs. Troughton & Simmes, of London, December, 1862, and among other appliances devised and attached to the same is M. Revoil's "Teleiconograph."

I never thought the idea of sufficient importance to give it a Greek name, or describe it in the journals, although I have used it to great advantage for seven years. At the time I devised this apparatus, I supposed the idea was one that might have occurred to many; but since it has come in for a Greek name and found place in the London *Builder*, I write to claim a share in the device. Messrs. Troughton & Simms will well remember constructing the apparatus, and I have it here now to substantiate my assertion. Without knowing it I have practised "Teleiconography" for seven years! and it may be that others have done the same, although Messrs. T. & S. never had before constructed one, as I had to make a sketch of the device.

Yours, etc.

W. H. Edgerton.

Improved Steam Engine.

According to the *Nottingham Journal* a very great improvement in the steam engine, amounting to a substantial discovery and invention, has just been patented by Mr. Worsop, of that city. The improvement consists in forcing heated air into the boiler of the engines now in use—the air and steam together passing from the boiler to work the engine. The inventor has a separate apparatus for pumping and drawing the cold air through a coil of pipes, and so heating it before it enters the boiler, but the cold air may also be taken directly into the boiler, and be made to take up its heat entirely from the water in it The advantages offered by the invention are stated to be threefold. "First and foremost, a saving of more than 40 per cent in fuel; secondly, an increased amount of motive power compared with the ordinary steam engine; and thirdly a diminished supply of water for boilers." A further advantage is also said to deserve attention, viz., "that the action of the air on the water is very beneficial, keeping it in a constant perturbation, thus tending to prevent slating." The journal states that experiments have been made in Nottingham, and the results as worked out by Mr. Amos, the chief engineer of the Royal Agricultural Society, and other practical engineers, verify the above statement of advantages. If these results should be confirmed by further trials, the importance of the invention will soon be felt—not the smallest advantage being, as the *Nottingham Journal* points out, the increased length of the voyages it will enable steamers to make without recoaling.

MISCELLANEA.

The coal dealers in London are obliged to have their wagons so made that each of them is, in effect, a weighing machine. By the use of a lever near the wheel, the load of coal is placed upon the scale and the true weight immediately and easily ascertained.

A new and elegant method of preparing nitrogen gas has been made known by a distinguished Italian chemist, Signor Massimo Levi. It consists in heating bichromate of ammonia in a retort; the salt is thus resolved into green oxide of chromium, water, and nitrogen gas.

The Light of Uranus.—This planet emits light which differs from that of any other of our system. According to Father Secchi, its spectrum exhibits broad absorption lines. The surface modifies the sun's light which it reflects, in the same manner as do colored bodies.

M. Personne, a French chemist, announces that the essence of turpentine is an antidote for poisoning by phosphorous. This will be agreeable news to persons engaged in the manufacture of matches, who are subject to many diseases caused by the inhalation of phosphoric fumes, which frequently result in caries of the jaw-bone. In support of his theory he publishes the following results of his experiments: To five dogs he administered doses of phosphorous varying from 1 to 3 grammes; to five others the same doses, followed in the course of on hour by ten grammes of essence of turpentine; and finally to five more the same doses of poison, immediately succeeded by the antidote. The first five all died; of the second series all recovered but one; while the last five appeared not to suffer the slightest inconvenience.

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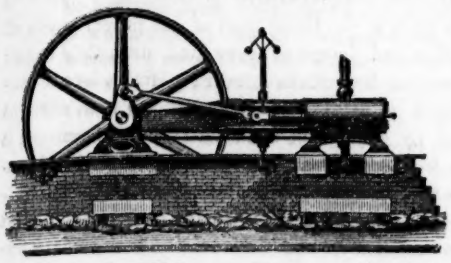

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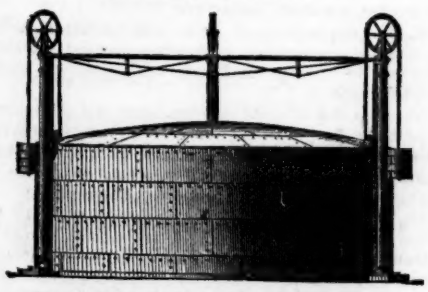

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[NOTE BY PROFESSOR WURTZ.—Contributions and items for which I am, as a Scientist, individually responsible, will have attached my full name or initials.—H. W.]

SATURDAY, OCTOBER 2, 1869.

WISHING TO MAKE this Journal an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers elicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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ON THE THEORIES OF FORCE AND MOTION.

It will be observed that the valuable paper of Professor WALLING, in our last CHEMICAL REPERTORY, has called forth an equally valuable rejoinder from Dr. VAN DER WEYDE. This is as it should be, and accords with our invitation, when introducing Professor WALLING's article. The subject must not rest as it is of the utmost importance, in the present stage of the science of heat, as well as of that of luminosity, to come to a definite and distinct comprehension of these doctrines. We cannot longer "agree to disagree" or even afford to disagree at all, upon these fundamental data, with which all our chemico-physical reasoning must begin. Again we urge that still others, among the many of our readers who are competent to do so, will impart their views. Can we not arrive at, or at least suggest, some crucial test, some absolute conclusive solution, of this great question of the existence or non-existence of Force? Or is the question, like that of the existence of the human soul, one wholly insoluble by human science, and therefore outside the domain of Physics? Dr. VAN DER WEYDE does not, and Professor WALLING doubtless would not, admit this latter proposition. In fact the susceptibility of *measurement* of Force, or at least of its effects, or rather of those effects attributed to its influence on matter, seems at war with any notion of its being an inscrutable, immeasurable, altogether ineffable thing, like the soul. Hence, doubtless, the repugnance of minds like that of Dr. VAN DER WEYDE, to the view of an inscrutable influence or agency. He succeeds in measuring and weighing and submitting to mathematical analysis, all things. The strict mathematician must find in nature but *matter*, or say ponderable mass, and *motion*, two things measurable, and multipliable into each other. But have we naught but M, MV, and MV^2 in Nature? Here is the question.

We shall not prejudge it, but wait to hear what master minds have to urge on both sides. Still, we are strongly tempted to suggest a point or two; especially as it may usefully aid in indicating where those who are not so facile in these subjects will incline to find points of difficulty. These points we take almost at random, among those that crowd upon us. Even though the soul *do not* exist, no one denies the existence of something, or rather of an almost infinite number and variety of somethings, which we class together under the general term *Life*, comprehending all the numerous distinct and *individual* kinds of vitality; and which up to this time remain, and for all we know may ever be, only less inscrutable than the soul itself. Still these are not wholly thrown out of the domain of Physics, their effects upon matter constituting a most important portion of the studies of mankind. This is one of the facts which seem to some to point, by analogy, to the possibility of the existence of other similar individual influences, like physical forces or modes of force. Some go so far even as to assume a "vital force," which must then have many modes, as well as a force of "chemical affinity," of which there must be an infinity of modes. On this very subject, the present writer intended to present some views at length, at the late meeting of the ASSOCIATION at Salem, but they were crowded out. He would be rejoiced to hear how the special students of these subjects bring into their respective theories the recognized influences of vitality or vitalities, and of affinity or affinities. The theory which leaves out the elements of clear conceptions of the nature, and relations to matter, of these all-powerful entities could not meet acceptation very widely.

Also what shall we call Gravitation, to whose universal influence Dr. VAN DER WEYDE (in a very grand and comprehensive generalization which he sets forth in the latter part of his paper) traces all motion and change of every kind since time began now, and henceforth forever? If this be not considered as a "Force," or called *by that name* at least, by what name shall we call it? Some call it the *tendency* of matter to its centre of gravity, deeming it possibly an inherent quality, like form, or divisibility. If so, then let us have a definition of what is a "tendency," and if this word is better than force or "attraction," let us then adopt it and use it. The thing called "motion" is admitted. Can it, as well as its negation, "rest," be defined (physically, we mean, and not merely mathematically)? And is there, or was there ever, any such thing as rest? If not, can it be conceived as possible? Which theory, if either, recognizes a period when motion *began*, however long the time be since: and did the universe start from a state of rest, and is it tending to a final state of rest? What are the relations of the *ethereal medium* to these two theories respectively? Dr. VAN DER WEYDE must doubtless accept its existence, as the medium of transfer to us of the cyclical modes of motion of the incandescent molecules, whose phases in the solar photosphere and chromosphere are shown to us by the spectroscope. But, is *it* matter, and does it gravitate? We believe Professor WALLING throws out *repulsion* altogether from his theory, and may find no use therefore for the ether. We should be grateful for some light on this last point from both gentlemen.

All these things and many more, it would be of the greatest interest to have explained, according to both theories, in the simplest and most "popular" language possible. Most of these seem to us not to be mere details, but, at least to ordinary minds who do not generalize mathematically, involve the primary postulates of any theory which will be finally grasped by such minds, *convey conceptions* thereto, and impress itself usefully thereon. H. W.

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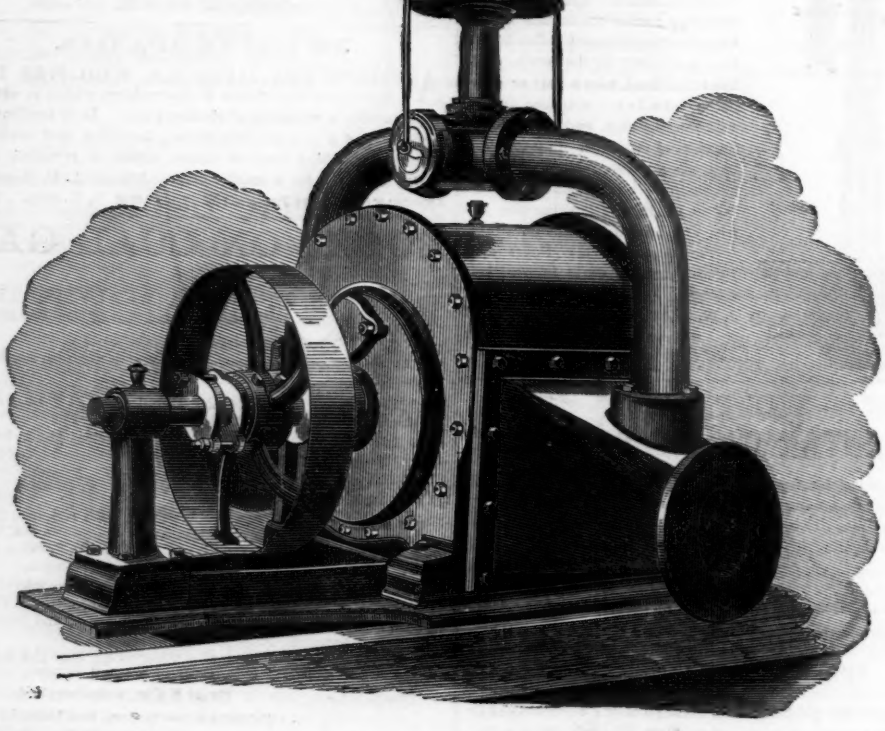

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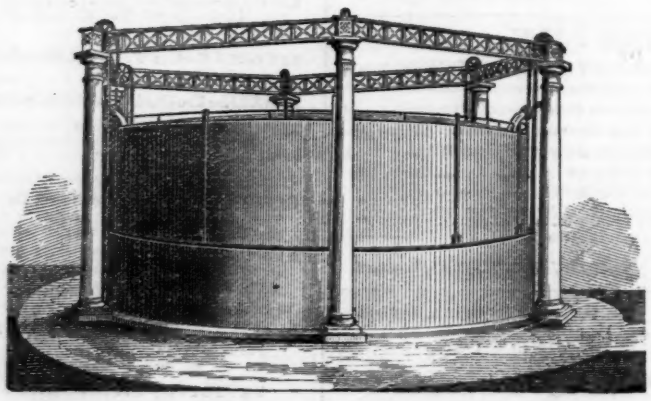

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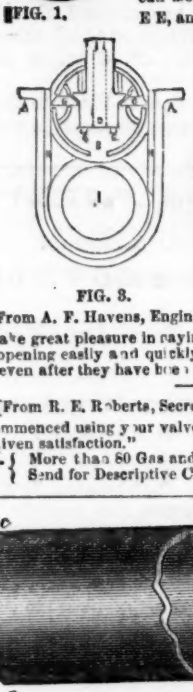

FIG. 3. FIG. 2.

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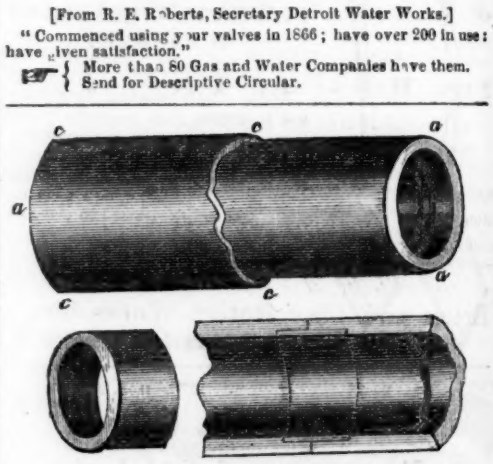

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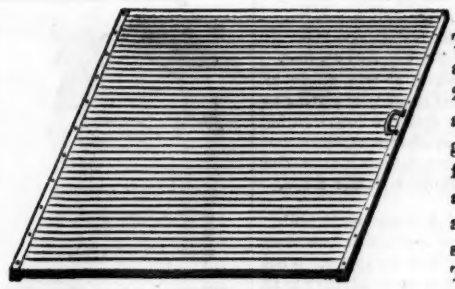

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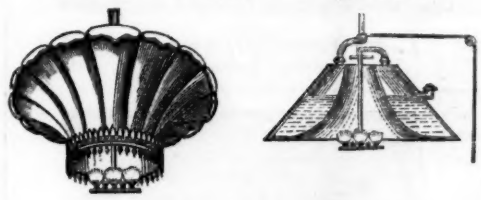

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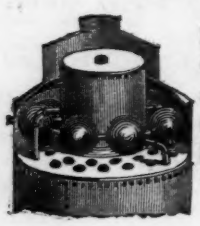

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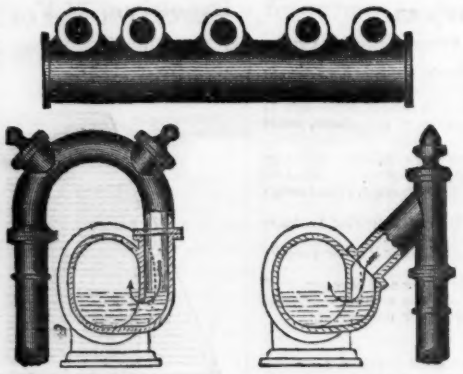

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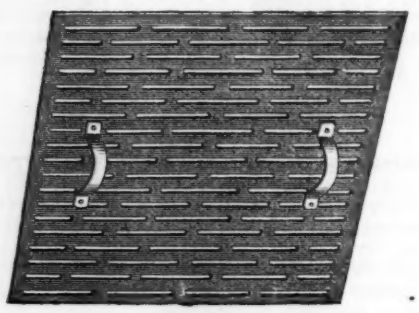

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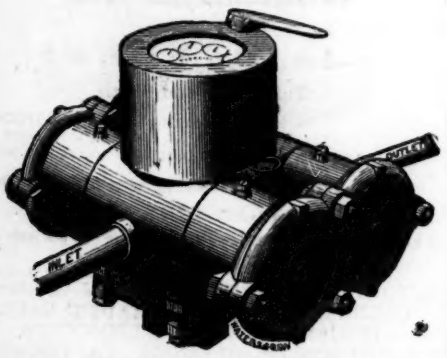

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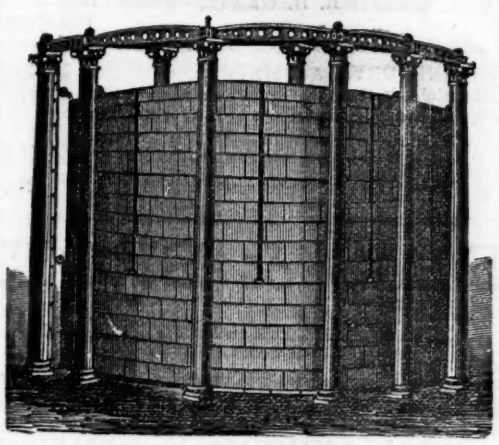

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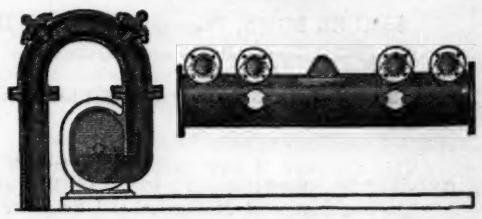

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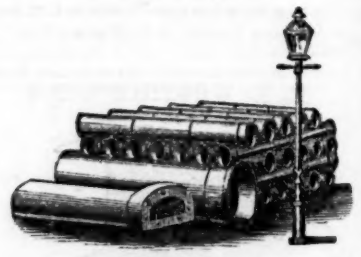

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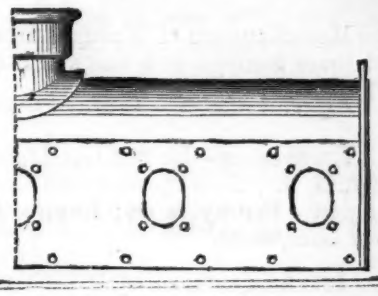

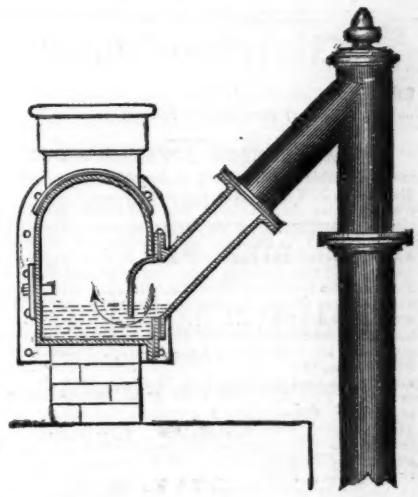

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